Electronic Supplementary Material (ESI) for RSC Advances

Supporting Information for

Facile one-pot synthesis of Au nanoparticles decorated porous α-Fe_2O_3 nanorods for in-situ detection of VOCs

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Summary

Seven pages, including Experimental Section and three figures.

Experimental Section

Materials

All reagents were of analytical grade and were used as purchased without further purification. Iron (II) sulfate heptahydrate ($FeSO_4 \cdot 7H_2O$) and anhydrous sodium acetate (CH_3COONa) were obtained from Guangfu Fine Chemical Research Institute (Tianjin, China). Gold(III) chloride tetrahydrate ($HAuCl_4 \cdot 4H_2O$) was purchased from Yingdaxigui Chemical Reagent Company (Tianjin, China). Distilled water was used throughout the experiments.

Synthesis of Au NPs decorated α-Fe_2O_3 NRs

The Au NPs decorated α-Fe_2O_3 NRs were synthesized by a facile one-pot hydrothermal method. 17.6 mL of clear well-mixed solution consisting 0.44 mmol $FeSO_4$, 0.88 mmol CH_3COONa and 9×10^{-4} mmol $HAuCl_4$ was transferred into a 22 mL Teflon-lined stainless steel autoclave. The hydrothermal process was conducted at 100^{o}C for 12 h in an electric oven. After the autoclave was allowed to cool down naturally to room temperature, the precipitate was centrifuged and washed with distilled water and absolute ethanol alternately, and then dried at 80^{o}C for 12h. The Au NPs decorated α-Fe_2O_3 NRs were obtained by calcining the precursor at 300^{o}C for 1 h in a muffle furnace.

Sample Characterization

Thermogravimetric analysis (TGA) was carried out on a ZRY-2P thermal analyzer

at a linear heating rate of 10 °C/min. The phase purity of the products was characterized by X-ray powder diffraction (XRD) using a Rigaku D/max-2500 diffractometer with Cu Kα radiation (λ=1.5418Å). The morphologies of the samples were investigated using a 1530VP field-emission scanning electron microscope (FESEM), 10 kV. Transmission electron microscopy (TEM) images, high-resolution TEM (HRTEM) images and energy dispersive X-ray spectroscopy (EDS) analyses were obtained on a Tecnai G2 F20(FEI, Holland) field-emission transmission electron microscope at 200 kV. X-Ray photoelectron spectroscopy (XPS) spectra were recorded using a ThermoFisher K-alpha X-ray photoelectron spectroscopy employing a monochromated Al-Ka X-ray source (hν= 1486.6 eV).

Fabrication of gas sensor and measurement of gas sensing performance

A proper amount of prepared sample was slightly grinded together with several drops of water in an agate mortar to form a homogeneous paste. Then the paste was coated onto an alumina tube with a Ni–Cr alloy coil inserted through the tube as a heater to control the operating temperature by tuning the heating voltage (V_h), and a pair of Au electrodes and four Pt wires on both ends. The alumina tube was then welded onto a pedestal with six probes (Fig. S1a) to give the final sensor unit (Fig. S1b) and put on the circuit board (Fig. S1c). Gas sensing tests were performed on a commercial WS-30A Gas Sensing Measurement System (Wei Sheng Electronics Co., Ltd., Henan, China, Fig. S1d) using ambient air as the dilute and reference gas at an operating temperature of 320 ^{o}C and a relative humidity of 10-15%. A load resistance (R_L) is connected in series to the sensor. The sensor in the gas chamber was aged for several weeks before testing. The sensor signal

voltage (V_{out}) was collected by a computer at a test circuit voltage of 5 V (V_c). The sensor was exposed to air again by opening the chamber when the test was completed. Fig. S1e shows the working principle of the WS-30A system.

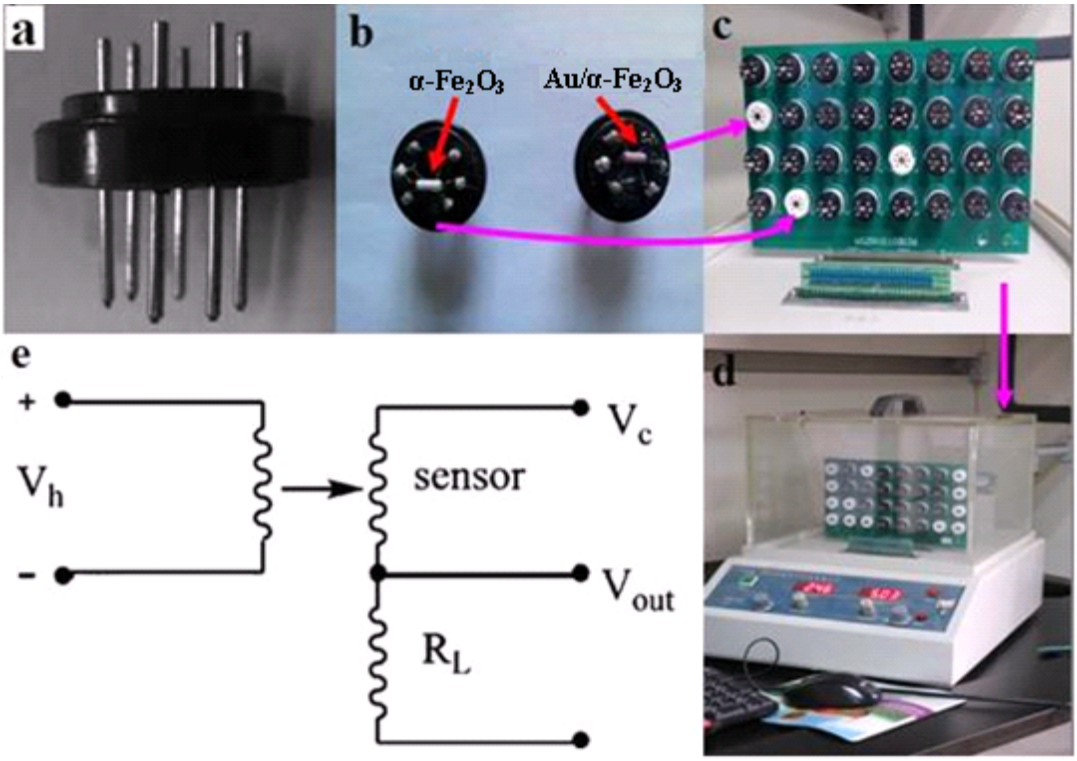

Fig. S1. Construction and test of gas sensor: sensor pedestal (a), completed sensor with alumina tube (b), circuit board (c), gas sensing measurement system (d) and working principle of gas sensor test (e).

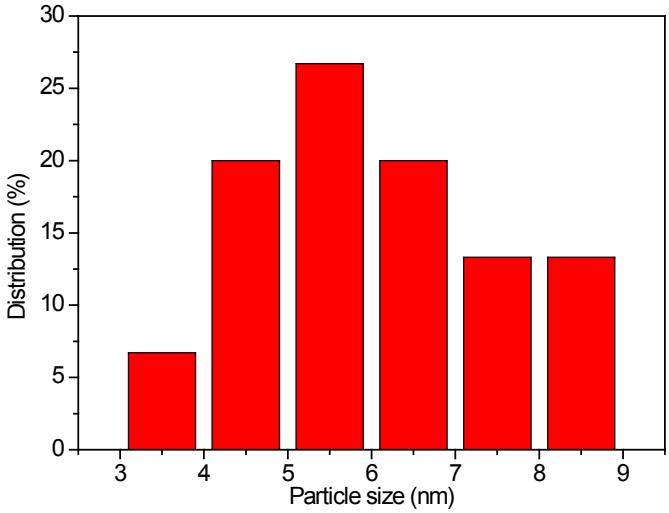

Fig. S2. Particle size distribution of Au NPs.

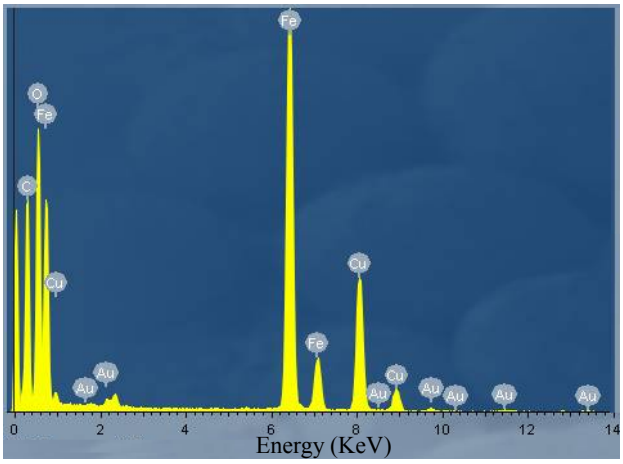

Fig. S3. The energy-dispersive X-ray spectrometry (EDS).